

CLAIMS

1. Method for the detection of chemical species present in a condensed medium, comprising the following steps:

- determination of the characteristic wavelengths and intensity values of back-scattered electromagnetic emission signals due to the fluorescence of chemical species excited in response to a multiplicity of electromagnetic excitations of distinct wavelengths of at least one chemical species that could be contained in said condensed medium;

- successive excitation of a multiplicity of surface elements of a surface portion of said condensed medium with a beam of laser means the tunable wavelength of which is capable of taking on at least one of the values of said distinct wavelengths of said multiplicity of electromagnetic excitations;

- successive recording of the wavelengths and intensity values of the electromagnetic emission signals back-scattered by each of said surface elements in response to the electromagnetic excitations produced by said beam;

- comparison at at least one excitation wavelength and at least one corresponding emission wavelength of the recorded intensity value of said electromagnetic signal back-scattered by each of said surface elements with said determined characteristic intensity value of said back-scattered electromagnetic signal of said chemical species that could be contained in said surface portion; and

- determination of the presence of said chemical species in each of said surface elements when said recorded intensity value of said electromagnetic signal back-scattered by said surface element is greater than a threshold defined at least by said determined characteristic intensity value of said back-scattered electromagnetic signal of said chemical species,

characterized in that it comprises a prior step of excitation of the surface element of the condensed medium with laser means and variation of the excitation frequency for a given chemical species in a manner such as to enable detection of the presence of said given chemical species on a portion of the surface of the condensed medium, the laser beam stemming from the laser means being concentrated on a surface element on a surface portion.

2. Method for the detection of chemical species according to claim 1, characterized in that one records successively the direction of said beam of the laser means for each surface element of said surface portion in a manner such as to reference the coordinates of the origin of said back-scattered electromagnetic emission signals by which one obtains the position of said chemical species in said surface portion.

3. Method for the detection of chemical species according to claim 1 or 2, characterized in that one moreover determines the concentration of said chemical species present in said medium by measuring the amount of energy emitted by said back-scattered electromagnetic emission signals.

4. Method for the detection of chemical species according to any one of claims 1 to 3, characterized in that one records in parallel the intensity values of said back-scattered electromagnetic emission signals and in that one records their corresponding wavelength.

5. Method for the detection of chemical species according to any one of claims 1 to 4, characterized in that moreover:

- one determines the characteristic intensity values of the back-scattered electromagnetic emission signals in response to an excitation after a given interval of time and during a given period of time of at least one chemical species that could be contained in said condensed medium;

- one records the intensity values of the back-scattered electromagnetic emission signals in response to an excitation of said condensed medium after said given interval of time and during said given period of time; and

- one compares said recorded intensity values and said determined intensity values in a manner so as to determine the presence of said chemical species in said condensed medium.

6. Device for detection of chemical species present in a condensed medium for the implementation of the method according to one of claims 1 to 5, comprising:

- means (14) for determining the characteristic wavelengths and intensity values of back-scattered electromagnetic emission signals (16) in response to a multiplicity of electromagnetic excitations (12) of distinct wavelengths of at least one chemical species that could be contained in said condensed medium (38);

- laser means (10) producing a beam (12) for successively exciting a multiplicity of surface elements of a surface portion of said condensed medium (38) according to wavelengths capable of taking on at least the values of said distinct wavelengths of said multiplicity of electromagnetic excitations;

- means for successively recording (14) the wavelengths and the intensity values of electromagnetic emission signals back-scattered (16) by each of said surface elements in response to the electromagnetic excitations produced by said beam; and

- comparison and determination means (18), for comparing at at least one excitation wavelength and at at least one corresponding emission wavelength the recorded intensity value of said electromagnetic signal back-scattered (16) by each of said surface elements to said determined characteristic intensity value of said back-scattered electromagnetic signal of said chemical species that could be contained in said condensed medium (38) and for determining the presence of said chemical species in each of said surface elements when said recorded intensity

value of said electromagnetic signal back-scattered (16) by said surface elements is greater than a threshold defined at least by said determined characteristic intensity value of said back-scattered electromagnetic signal of said chemical species, characterized in that the recording means (14) are connected to a central unit of a computer (20) which presents a memory capable of storing notably simultaneously the wavelength of the back-scattered signals (16) and its intensity for a sequential archiving, surface element by surface element, indexed by the displacement means 36 and stored in the memory of the computer (20) the measurements of intensity and wavelengths of the back-scattered signals.

7. Device for detection of chemical species according to claim 6, characterized in that said laser means (10) comprise:

- a pump laser (22) associated with a frequency doubler; and
- a parametric oscillator (28) to which said pump laser (22) is coupled in a manner so as to emit radiation the tunable wavelength of which is between 200 and 800 nm.

8. Device for detection of chemical species according to claim 6, characterized in that said laser means (10) comprise a pumping source operating in femtosecond mode.

9. Device for detection of chemical species according to any one of claims 6 to 8, characterized in that said laser means (10) producing a beam (12) comprise means (36) for orientation of said beam for exciting said multiplicity of said surface elements of said surface portion of said condensed medium (38) in a manner to analyze the back-scattered electromagnetic emission signals (16) originating from each of said surface elements and of determining the presence of at least one of said chemical species in each of said surface elements of said surface portion.

10. Device for detection of chemical species according to claim 9, characterized in that it comprises means for successively recording the direction of said beam of the laser means for

each surface element of said surface portion in a manner such as to reference the coordinates of the origin of said back-scattered electromagnetic emission signals such that one obtains the position of said chemical species in said surface portion.

11. Device for detection of chemical species according to any one of claims 6 to 9, characterized in that it comprises recording means comprising a spectrometer (40) coupled to a matrix of photodetectors (42) in a manner so as to record in parallel the intensity values of said back-scattered electromagnetic emission signals (16) and to record their corresponding wavelengths.